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Title of Invention	MACHINE BODY ANTENNA

Application Number :

Date :

First Named Applicant: Mr. Tae Ri Lee P.Eng.

Confirmation Number:

Attorney Docket Number:

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Documents being submitted:	Files
us-fee-sheet	SSTWirelessProv-usfees.xml
	us-fee-sheet.xsl
	us-fee-sheet.dtd
us-request	SSTWirelessProv-usrequ.xml
	us-request.dtd
	us-request.xsl
application-body	MachineBody-trans.xml
	us-application-body.xsl
	application-body.dtd
	wipo.ent
	mathml2.dtd
	mathml2-qname-1.mod
	isoamsa.ent
	isoamsb.ent
	isoamsc.ent
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	isolat1.ent
	isolat2.ent
	isonum.ent
	isopub.ent
	mmlextra.ent
	mmlalias.ent
	soextblx.dtd
	Figure01.TIF
	Figure02.TIF
	Figure03.TIF
	Figure04.TIF
	Figure05.TIF
	Figure06.TIF
	Figure07.TIF
	Figure08.TIF
Comments	

APPLICATION DATA SHEET

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Title of Invention	MACHINE BODY ANTENNA

Application Type : provisional, utility

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Description

[*MACHINE BODY ANTENNA*]

BACKGROUND OF INVENTION

0001] This invention relates to antennas used in the transmission and reception of electromagnetic radiation in the radio spectrum for the purpose of wirelessly conveying information from one location to another. More specifically this relates to communication between a centralized system or systems and one or more sensors in close proximity to the machine body.

[0002] It is known that when using wireless devices and sensor systems on machines for accurate monitoring and control of aspects of the machine, that line of sight transmission is not always possible, leading to signal blockage, multipath issues, and consequential increased transmission power requirements for the sensors and the interrogating node(s).It is also known that all that is required to emit electromagnetic waves is electrons in motion.A dipole antenna is basically a resonant narrow-band device, with a marked bi-directional pattern. A loop antenna is essen-

tially a magnetic field receiving device, the sensitivity of which is a function of area and the number of turns. Loop antennas suffer significant losses due to re-radiation, because they are closed circuits in which current low is maximized. Electrostatic antennas, using solid flat plates are used for reception of electromagnetic waves, are effective only in that part of the electromagnetic spectrum where the capacity reactance of the solid plate matches the transmission line.Applicant is aware of patents regarding such:Planar antennas Lamberty US Patent 3,050,730, which describes a number of high frequency un-tuned antennae composed of a plurality of generally rectangular plates of conducting material in various planes.Marko US Patent 5,184,143 describes a low profile antenna including a rectangular driven element.Sheriff US Patent 4,975,713 describes a planar antenna using a conductive panel-shaped open-weave mesh element in conjunction with a solid planar conductive element.Ultra Wide Band Ross US Patent 3,728,632 describes the first embodiment of Ultra Wide Band in an electromagnetic signal communication system using short base-band pulse signals.

SUMMARY OF INVENTION

[0003] The present invention serves to provide a means to wire-

lessly communicate between one or more devices mounted in close proximity to a machine or machine body, taking advantage of the machine body as a radiating element in order to reduce the emitting power requirements of battery powered devices such as sensors so mounted.

Brief Description of Drawings

[0004] Figure 1 – Shows a simple block diagram of the Master or Interrogating Node of a system using a machine body antenna.

[0005] Figure 2 Shows a simple block diagram of the Slave or Remote Wireless Device of a system using a machine body antenna.

[0006] Figure 3 Shows a simple physical block diagram of a system using a machine body antenna with free air propagation of electromagnetic waves.

[0007] Figure 4 – Shows a simple physical block diagram of a system using a machine body antenna with bound RF signal propagation along antenna connection means to Slave or Remote Wireless Devices.

[0008] Figure 5 – shows a simplified physical model of a automobile embodiment of the machine body antenna.

[0009] Figure 6 shows a simplified electrical model of an auto-

mobile embodiment of the machine body antenna in conjunction with wireless sensing devices.

[0010] Figure 7 shows in medium detail a block diagram of an embodiment of a master or interrogator node connected to a machine body antenna in a automobile application.

[0011] Figure 8 shows in medium detail a block diagram of an embodiment of a remote sensor for use with a system using a machine body antenna as in a automobile application.

[0012] Drawing Index

Item	*Description*
1	Earth Ground
2	Ground Insulating Means
3	Machine Body
4	Master Module
5	Master Antenna Connecting Means
6	Slave Module
7	Slave Antenna Connecting Means
8	Slave Antenna
9	Free air Propogating Electromagnetic Waves
10	Bound or conducting RF Signal

DETAILED DESCRIPTION

[0013] The present invention is a machine body isolated from

earth ground acting as a driven un-tuned antenna. Applications of this include wireless communication between a central point on the machine and sensing devices mounted on or near the machine, such as in a wireless tire pressure measurement system on a motor vehicle. Such systems include one or more Master Modules or Interrogating Nodes, as shown in block diagram of Figure 1, which generally poll or monitor one or more Slave or Remote Wireless Devices for sensor information, to activate remote signals, or actuate other functions as shown in block diagram of Figure 2.

0014] The body of the machine is driven by a transmitter circuit at specific or spread spectrum radio frequency(s) using a variety of modulating techniques to induce electric currents within the body and thereby causing the body to emit electromagnetic waves as shown in Figure 3. The machine body 3 is isolated from earth ground 1 by ground insulating means 2. The machine body is electrically driven by master module 4 through master antenna connecting means 5 so as to radiate free air electromagnetic waves 9 to poll or command the slave modules 6 through slave antenna 8.

[0015] Similarly in the motor vehicle application as shown in Fig-

ure 6, the car body acts as an antenna for transmission and reception of electromagnetic waves impinging on it and can be connected to a receiver circuit in the master module for demodulation and decoding of information previously transmitted as illustrated in Figure 7.

)016] The body of the ground isolated machine acting as antenna can be modeled like any other antenna as a network of inductors and capacitors, and more generally can be modeled as a planar antenna as shown in Figure 5. As with most objects the machine body may have electrically resonant frequencies, which may or may not be of value when used as antenna. The major benefit of the machine body antenna is its distributed nature and the effectiveness achieved when communicating with radio frequency devices in its "Near Field", permitting lower transmission power requirements for the near field devices.

[0017] In the instance of a motor vehicle, the body of the motor vehicle acts as an antenna. In the application of sensors such as tire pressure measurement sensors, the sensors are generally within the near field of the motor vehicle body as shown in Figure 6. The tire pressure measurement sensor requirements are that it reliably convey tire temperature and pressure to motor vehicle onboard sys-

tem(s) over an operating life of at least 5 years without battery replacement. This would indicate a low transmission power requirement for the sensor.

[0018] For example such sensors may transmit at a conventional frequency of 433 Mhz with a wavelength of approximately 28 inches. The near field of an antenna is generally accepted to be within several wavelengths away from the transmitting antenna and is specifically defined as "The close-in region of an antenna wherein the angular field distribution is dependent upon distance from the antenna." The electromagnetic wave intensity diminishes with distance from the source at a rate of $1/R^2$, so it stands to reason that in order to minimize the power consumption of wireless transmitting sensors that they be located as close as possible to the antenna with which they are communicating.

[0019] A tire pressure measurement system can be implemented in a motor vehicle by using the vehicle body as a machine body antenna. This places each tire sensor within the near field of the antenna reducing its power requirements, while also eliminating the costly installation of individual antennas at or near each wheel on the vehicle.

[0020] The initial embodiments of applications using the present

invention will incorporate either Frequency Shift Keying (FSK) or Phase Shift Keying (PSK) Modulation primarily due to the availability of transceivers using those modulation schemes, however the present invention is not limited to these and other modulation schemes are possible such as the carrier-less Ultra Wideband Technology using impulse excitation.

0021] Applications of "Smart Antenna Systems"can incorporate the present invention with one or more additional tuned antennas to enhance system performance and / or reliability. Embodiments of the Smart Antenna System may include summing of the various antenna signals in a phase coherent manner, or phase incoherent manner, or time domain multiplexing of the antenna sources and dynamic selection of signal source. The Smart Antenna System using phase information could also be employed to locate sensors relative to the smart antenna system. One embodiment of the Smart Antenna System is the present invention Machine Body Antenna with multiple feed points between the transceiver and the Machine Body, creating multiple virtual Machine Body Antennae, and a virtual phased array.

[0022] Given the geometric complexity of various machine bod-

ies, their emission patterns at various frequencies, and desired wireless device or sensor placement on or near the body it is desirable that the wireless sensor system using the machine body antenna be able to dynamically adapt its operating frequency(ies) by sensor to optimize signaling to and from each sensor. One element that would be useful in this regard is to incorporate a Signal Strength feedback loop from the sensors to the interrogating nodes, and a feed forward frequency selection loop from the node to the individual sensors. With each sensor having its own unique id, combined with the signal strength feedback, and frequency selection feed forward the interrogating node(s) may dynamically adjust for optimum performance of the machine body antenna on a sensor by sensor basis.

[0023] Ideally on machines where specific sensor location information is desired by the interrogating node(s), an automatic scheme for locating the sensors as described above would be used. In the absence of a auto-locating scheme the interrogating nodes will require manual programming of each sensor location.

[0024] Using a machine body isolated from earth ground as an antenna has additional benefits over a conventional tuned

antenna for communicating with wireless devices near the machine body. In particular a reduction in signal variance has been observed providing more stability in the signal and thereby enabling the system to operate reliably with a lower signal to noise ratio than a conventional tuned antenna.

)025] A further embodiment shown in block diagram of Figure 4 is to connect the remote wireless devices 6 directly to the machine body 4, using the machine body 4 as the propagation medium instead of air. This can significantly improve signal strength and signal to noise characteristics of the machine body antenna system, without compromising or hindering the motion of the remote device or sensor.

0026] As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention without departing from the spirit or scope thereof.

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Claims

:1] Provisional Application – No claims made at this time.

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[*MACHINE BODY ANTENNA*]

Abstract

This invention relates to antennas used in the transmission and reception of electromagnetic radiation in the radio spectrum for the purpose of wirelessly conveying information from one location to another. More specifically this relates to communication between a centralized system or systems and one or more sensors in close proximity to the machine body.

Master or Interrogating Node

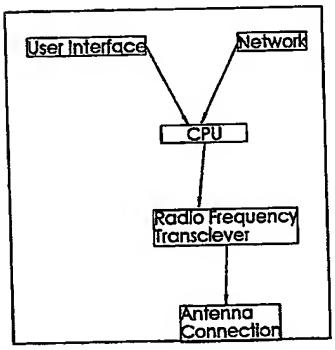

FIGURE 1

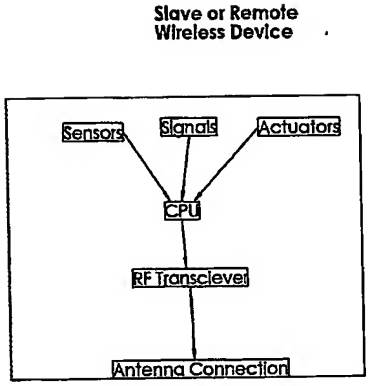
Slave or Remote
Wireless Device
Sensors
Signals
Actuators
CPU
RF Transciever
Antenna Connection

FIGURE 2

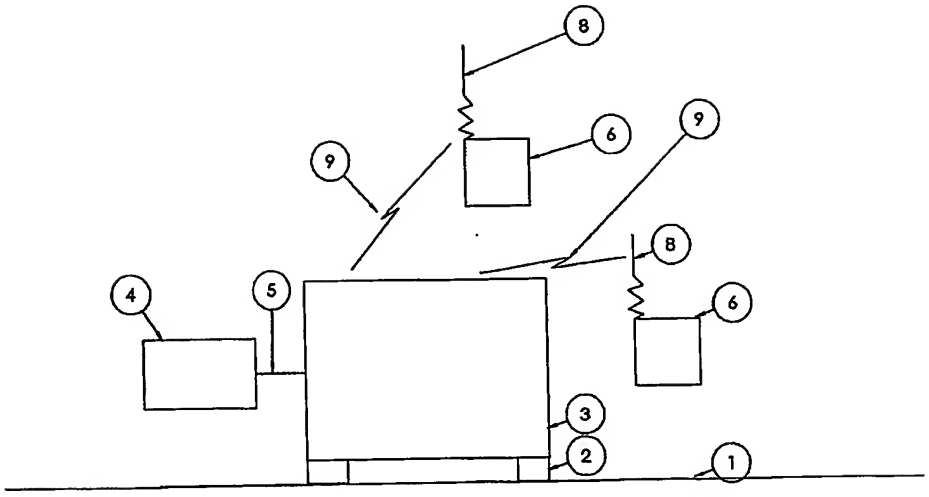

FIGURE 3

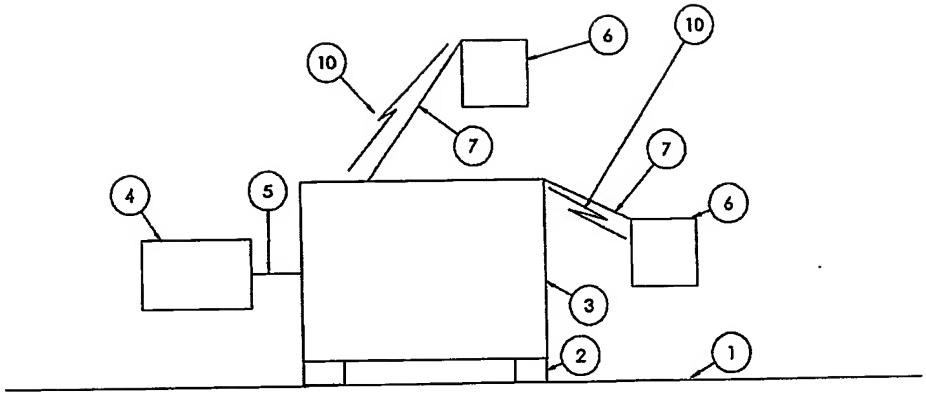

FIGURE 4

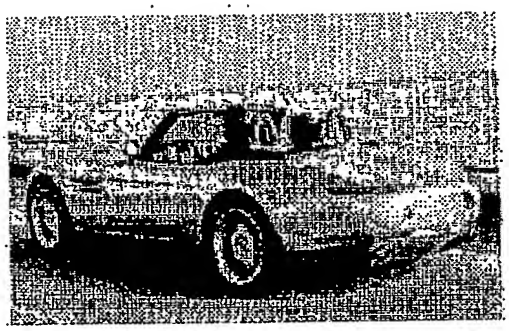

Figure 5.3 A Car on the Road

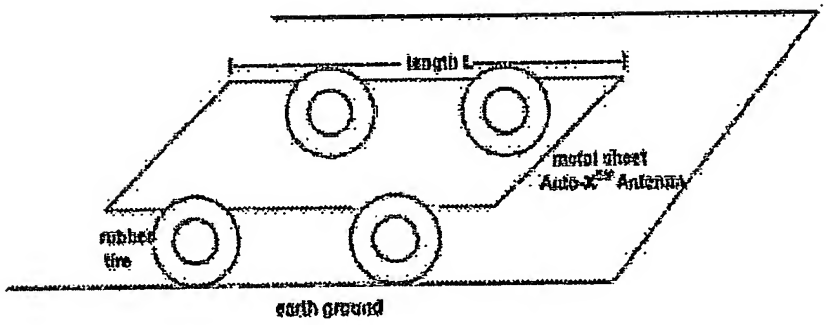

Figure 5.2 A Simplified Model of a Car Above the Earth Ground

FIGURE 5

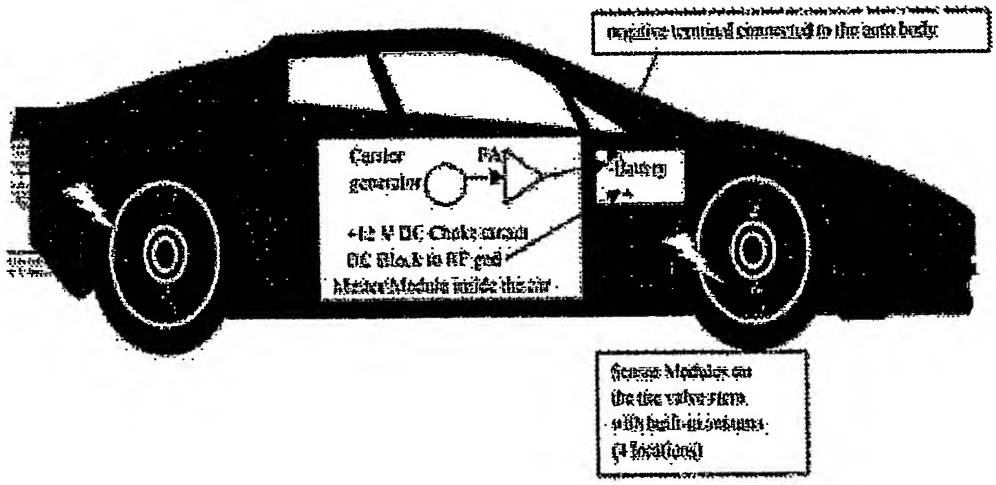
negative terminal connected to the auto body
Carrier generator
PA
Battery
+12 V DC Clock circuit
DC Block to RF coil
Master Module inside the car
Sensor Modules on the tire valve stem with built-in antenna (4 locations)

FIGURE 6

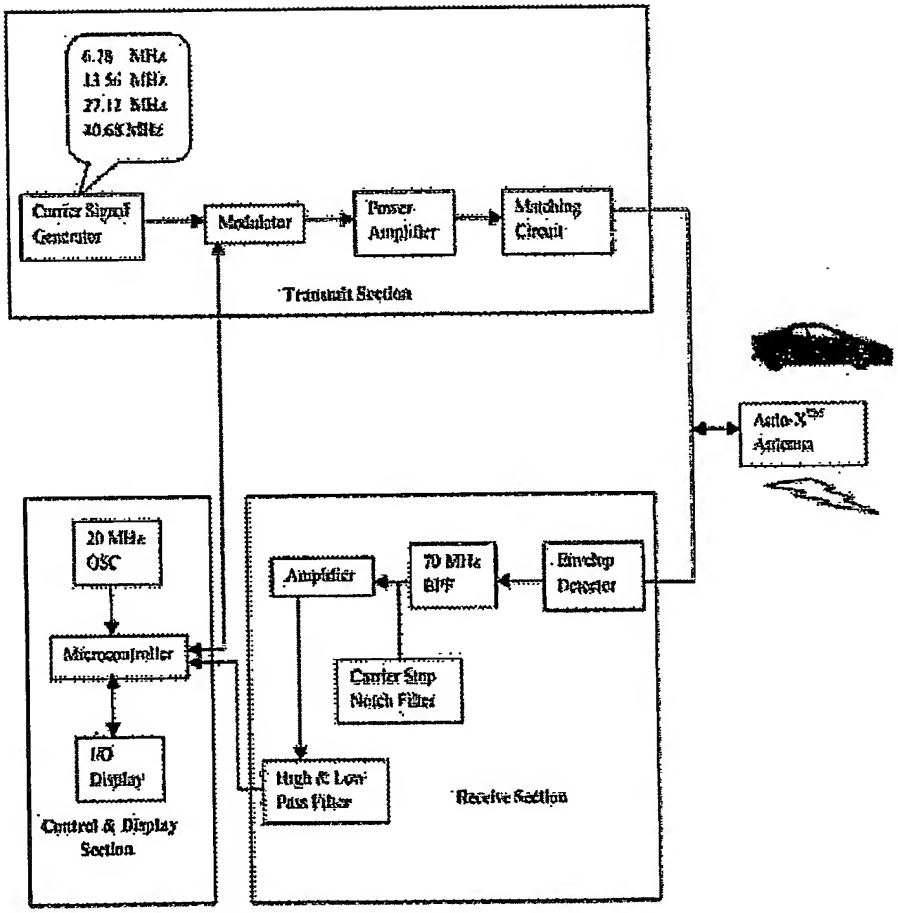
6.78 MHz
13.56 MHz
27.12 MHz
40.68 MHz
Carrier Signal Generator
Modulator
Power Amplifier
Matching Circuit
Transmit Section
Auto-X
Antenna
20 MHz OSC
Microcontroller
LCD Display
Control & Display Section
Amplifier
70 MHz BPF
Envelop Detector
Carrier Stop Notch Filter
High & Low Pass Filter
Receive Section

FIGURE 7

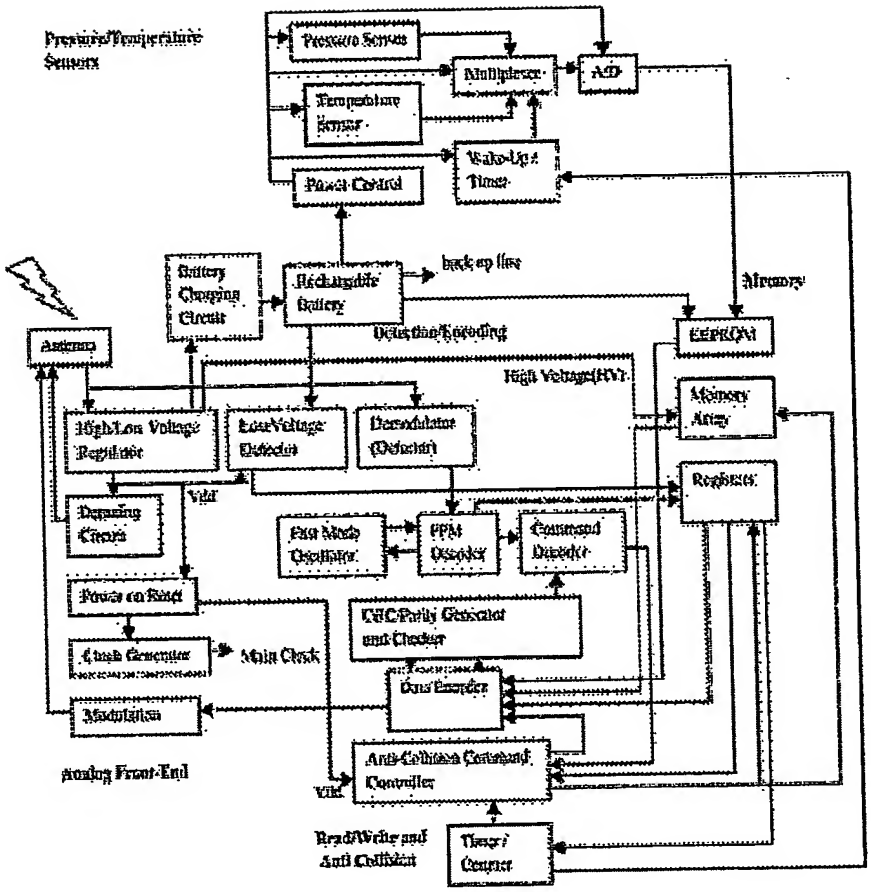
Pressure/Temperature Sensors
Pressure Sensor
Multiplexer
A/D
Temperature Sensor
Power Control
Wake-Up Timer
Battery Charging Circuit
Rechargable Battery
back up line
Memory
Antenna
Detection/Encoding
EEPROM
High Voltage(HV)
Memory Array
High/Low Voltage Regulator
Low Voltage Detector
Demodulator (Detector)
Registers
Valid
Damping Circuit
Bit Mode Oscillator
FPM Decoder
Command Decoder
Power on Reset
CRC/Parity Generator and Checker
Clock Generator
Main Clock
Bus Encoder
Modulation
Analog Front-End
Anti-Collision Command Controller
Valid
Read/Write and Anti Collision
Timer/ Counter

FIGURE 8

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